



SEQUENCE LISTING

<110> Angelis, Bryan
<120> HEPARIN/HEPAROSAN SYNTHASE FROM P. MULTOCIDA, SOLUBLE AND SINGLE ACTION CATALYSTS THEREOF AND METHODS OF MAKING AND USING SAME
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<150> 60/458,939
<151> 2003-03-31
<150> 10/142,143
<151> 2002-05-08
<150> 60/289,554
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<150> 60/296,386
<151> 2001-06-06
<150> 60/303,691
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<150> 60/313,258
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 Lys Phe Ser Val Ser Ile Lys Asp Leu Tyr Asn Glu Ile Ser Asn Ser
 65 70 75 80
 Glu Leu Gly Ile Thr Lys Glu Arg Leu Gly Ala Pro Pro Leu Val Ser
 85 90 95
 Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile Glu Ala Ser Ile
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 Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu Val Ile Val Val
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 Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala Ser Arg Ile Ala
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 Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly Asp Ile
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 Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn Ile Ile Lys Val

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 Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu Gly Val Tyr Arg
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 Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr Thr Lys Ala Ser
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 260 265 270
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 Ser Leu Phe Ser Asp Met Val Glu Trp Val Asp Glu Asn Asn Ile Lys
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 Gln Lys Thr Ser Asp Ala Arg Gln Asn Tyr Leu His Glu Phe Gln Lys
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 Ile His Asn Glu Arg Lys Leu Asn Glu Leu Lys Glu Ile Phe Ser Phe
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 Pro Arg Ile His Asp Ala Leu Pro Ile Ser Lys Glu Met Ser Lys Leu
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 Ser Asn Pro Lys Ile Pro Val Tyr Ile Asn Ile Cys Ser Ile Pro Ser
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 Arg Ile Lys Gln Leu Gln Tyr Thr Ile Gly Val Leu Lys Asn Gln Cys
 370 375 380
 Asp His Phe His Ile Tyr Leu Asp Gly Tyr Pro Glu Val Pro Asp Phe
 385 390 395 400
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 Asn Glu Ser Ile Arg Asp Asn Gly Lys Phe Ile Leu Leu Glu Lys Leu
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 Ile Lys Glu Asn Lys Asp Gly Tyr Tyr Ile Thr Cys Asp Asp Asp Ile
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 Lys Pro Leu Glu Asn Asp Thr Ala Val Asn Ile Leu Gly Thr Gly Thr
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 Glu His Pro Gly Met Val Asp Ile Tyr Phe Ser Ile Leu Cys Lys Lys

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535

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Asn Asn Ile Leu Gln Val Cys Ile Ser Arg Pro Ser Asn Trp Leu Thr
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Asp Glu Ile Gln Ser Lys Leu Ile Ile Ser Asn Asn Pro Trp Gly Tyr
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<211> 1854

<212> DNA

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tctggagaaa acaaattttc agtatcaata aaagatctat ataacgaaat aagcaatagt      240
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Gln Ser Lys Ser Asn Lys Ile Glu Glu Asp Asn Ile Ser Gly Glu Asn
50 55 60

Lys Phe Ser Val Ser Ile Lys Asp Leu Tyr Asn Glu Ile Ser Asn Ser
65 70 75 80

Glu Leu Gly Ile Thr Lys Glu Arg Leu Gly Ala Pro Pro Leu Val Ser
85 90 95

Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile Glu Ala Ser Ile
100 105 110

Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu Val Ile Val Val
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Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala Ser Arg Ile Ala
130 135 140

Asn Ser Thr Ser Lys Val Lys Thr Phe Arg Leu Asn Ser Asn Leu Gly
145 150 155 160

Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly Asp Ile
165 170 175

Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His Glu Arg Ile Glu
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Arg Cys Val Asn Ala Leu Leu Ser Asn Lys Asp Asn Ile Ala Val Arg
195 200 205

Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn Ile Ile Lys Val
210 215 220

Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu Gly Val Tyr Arg
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Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr Thr Lys Ala Ser

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Asp Ser Leu Lys Thr Thr Leu Asn Lys Asp Ile Ile Ser Gln Gln Thr
35 40 45

Leu Leu Ala Lys Gln Asp Ser Lys His Pro Leu Ser Ala Ser Leu Glu
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Asn Glu Asn Lys Leu Leu Lys Gln Leu Gln Leu Val Leu Gln Glu
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Phe Lys Lys Ile Tyr Thr Tyr Asn Gln Ala Leu Glu Ala Lys Leu Glu
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Lys Asp Lys Gln Thr Thr Ser Ile Thr Asp Leu Tyr Asn Glu Val Ala
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Lys Ser Asp Leu Gly Leu Val Lys Glu Thr Asn Ser Ala Asn Pro Leu
115 120 125

Val Ser Ile Ile Met Thr Ser His Asn Thr Ala Gln Phe Ile Glu Ala
130 135 140

Ser Ile Asn Ser Leu Leu Leu Gln Thr Tyr Lys Asn Ile Glu Ile Ile
145 150 155 160

Ile Val Asp Asp Asp Ser Ser Asp Asn Thr Phe Glu Ile Ala Ser Arg
165 170 175

Ile Ala Asn Thr Thr Ser Lys Val Arg Val Phe Arg Leu Asn Ser Asn
180 185 190

Leu Gly Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly
195 200 205

Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His Glu Arg
210 215 220

Ile Glu Arg Cys Val Asn Ile Leu Leu Ala Asn Lys Glu Thr Ile Ala
225 230 235 240

Val Arg Cys Ala Tyr Ser Arg Leu Ala Pro Glu Thr Gln His Ile Ile
245 250 255

Lys Val Asn Asn Met Asp Tyr Arg Leu Gly Phe Ile Thr Leu Gly Met

580 585 590
 Leu Thr Glu Asp Asn Arg Asp Ser Glu Thr Leu Tyr His Gln Tyr Arg
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 Asp Asn Asp Glu Gln Gln Thr Gln Leu Ile Met Glu Asn Gly Pro Trp
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 35 40 45
 Lys Leu Asn Pro Val Ile Pro Asp Lys Asp Tyr Lys Asp Val Gly Lys
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 Phe Ile Phe Pro Cys Ala Lys Asn Asp Met Ile Val Leu Thr Asp Asp
 65 70 75 80
 Asp Ile Ile Tyr Pro Pro Asp Tyr Val Glu Lys Met Leu Asn Phe Tyr
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 Asn Ser Phe Ala Ile Phe Asn Cys Ile Val Gly Ile His Gly Cys Ile
 100 105 110
 Tyr Ile Asp Ala Phe Asp Gly Asp Gln Ser Lys Arg Lys Val Phe Ser
 115 120 125
 Phe Thr Gln Gly Leu Leu Arg Pro Arg Val Val Asn Gln Leu Gly Thr
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 Gly Thr Val Phe Leu Lys Ala Asp Gln Leu Pro Ser Leu Lys Tyr Met
 145 150 155 160
 Asp Gly Ser Gln Arg Phe Val Asp Val Arg Phe Ser Arg Tyr Met Leu
 165 170 175
 Glu Asn Glu Ile Gly Met Ile Cys Val Pro Arg Glu Lys Asn Trp Leu
 180 185 190
 Arg Glu Val Ser Ser Gly Ser Met Glu Gly Leu Trp Asn Thr Phe Thr
 195 200 205
 Lys Lys Trp Pro Leu Asp Ile Ile Lys Glu Thr Gln Ala Ile Ala Gly
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Tyr Ser Lys Leu Asn Leu Glu Leu Val Tyr Asn Val Glu Gly
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Val Asp Leu Gln His Lys Asn Ser Pro Leu Lys Gly Asn Asp Asn Leu
 35 40 45

Ile His Lys Arg Ile Asn Glu Tyr Asp Asn Val Leu Glu Leu Ser Lys
 50 55 60

Asn Val Ser Ala Gln Asn Ser Gly Asn Glu Phe Ser Tyr Leu Leu Gly
 65 70 75 80

Tyr Ala Asp Ser Leu Arg Lys Val Gly Met Leu Asp Thr Tyr Ile Lys
 85 90 95

Ile Val Cys Tyr Leu Thr Ile Gln Ser Arg Tyr Phe Lys Asn Gly Glu
 100 105 110

Arg Val Lys Leu Phe Glu His Ile Ser Asn Ala Leu Arg Tyr Ser Arg
 115 120 125

Ser Asp Phe Leu Ile Asn Leu Ile Phe Glu Arg Tyr Ile Glu Tyr Ile
 130 135 140

Asn His Leu Lys Leu Ser Pro Lys Gln Lys Asp Phe Tyr Phe Cys Thr
 145 150 155 160

Lys Phe Ser Lys Phe His Asp Tyr Thr Lys Asn Gly Tyr Lys Tyr Leu
 165 170 175

Ala Phe Asp Asn Gln Ala Asp Ala Gly Tyr Gly Leu Thr Leu Leu Leu
 180 185 190

Asn Ala Asn Asp Asp Met Gln Asp Ser Tyr Asn Leu Leu Pro Glu Gln
 195 200 205

Glu Leu Phe Ile Cys Asn Ala Val Ile Asp Asn Met Asn Ile Tyr Arg
 210 215 220

Ser Gln Phe Asn Lys Cys Leu Arg Lys Tyr Asp Leu Ser Glu Ile Thr
 225 230 235 240

Asp Ile Tyr Pro Asn Lys Ile Ile Leu Gln Gly Ile Lys Phe Asp Lys
 245 250 255

Lys Lys Asn Val Tyr Gly Lys Asp Leu Val Ser Ile Ile Met Ser Val
 260 265 270

Phe Asn Ser Glu Asp Thr Ile Ala Tyr Ser Leu His Ser Leu Leu Asn
275 280 285

Gln Thr Tyr Glu Asn Ile Glu Ile Leu Val Cys Asp Asp Cys Ser Ser
290 295 300

Asp Lys Ser Leu Glu Ile Ile Lys Ser Ile Ala Tyr Ser Ser Ser Arg
305 310 315 320

Val Lys Val Tyr Ser Ser Arg Lys Asn Gln Gly Pro Tyr Asn Ile Arg
325 330 335

Asn Glu Leu Ile Lys Lys Ala His Gly Asn Phe Ile Thr Phe Gln Asp
340 345 350

Ala Asp Asp Leu Ser His Pro Glu Arg Ile Gln Arg Gln Val Glu Val
355 360 365

Leu Arg Asn Asn Lys Ala Val Ile Cys Met Ala Asn Trp Ile Arg Val
370 375 380

Ala Ser Asn Gly Lys Ile Gln Phe Phe Tyr Asp Asp Lys Ala Thr Arg
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Met Ser Val Val Ser Ser Met Ile Lys Lys Asp Ile Phe Ala Thr Val
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Gly Gly Tyr Arg Gln Ser Leu Ile Gly Ala Asp Thr Glu Phe Tyr Glu
420 425 430

Thr Val Ile Met Arg Tyr Gly Arg Glu Ser Ile Val Arg Leu Leu Gln
435 440 445

Pro Leu Ile Leu Gly Leu Trp Gly Asp Ser Gly Leu Thr Arg Asn Lys
450 455 460

Gly Thr Glu Ala Leu Pro Asp Gly Tyr Ile Ser Gln Ser Arg Arg Glu
465 470 475 480

Tyr Ser Asp Ile Ala Ala Arg Gln Arg Val Leu Gly Lys Ser Ile Val
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 Phe Tyr Gln Thr Pro Glu Val Asn Asp Val Val Asp Glu Arg Glu Phe
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 Ser Ala Val Gln Val Ser Thr Met Trp Asp Ser Met Val Leu Glu Leu
 65 70 75 80
 Met Met Asn Asn Leu Asn Asn Lys Leu Trp Gly Trp Ala Asp Pro Ser
 85 90 95
 Ile Ile Phe Phe Leu Asp Phe Trp Lys Asn Ile Asp Lys Ser Ile Lys
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 Phe Ile Met Ile Tyr Asp His Pro Lys Tyr Asn Leu Met Arg Ser Val
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 Asn Asn Ala Pro Leu Ser Leu Asn Ile Asn Asn Ser Val Asp Asn Trp
 130 135 140
 Ile Ala Tyr Asn Lys Arg Leu Leu Asp Phe Phe Leu Glu Asn Lys Glu
 145 150 155 160
 Arg Cys Val Leu Ile Asn Phe Glu Ala Phe Gln Ser Asn Lys Lys Asn
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 Ile Ile Lys Pro Leu Ser Asn Ile Ile Lys Ile Asp Asn Leu Met Ser
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 225 230 235 240
 Val Ser Glu Tyr Leu Val Ser Glu Leu Ile Lys Glu Arg Thr Glu Val
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 Glu Thr Ser Lys Asp Asn Val Ser Ala Glu Ala Ala Leu Trp Glu Val
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 Glu Ser Lys Lys Lys Asp Ala Asp Ile Glu Leu Thr Lys Ser Ile Phe
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 Lys Lys Arg Gln Phe Leu Leu Leu Asn Arg Ile Asn Glu Leu Lys Lys
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 Glu Lys Glu Glu Val Ile Lys Leu Ser Lys Ile Asn His Asn Asp Val
 340 345 350

Val Arg Gln Glu Lys Tyr Pro Asp Asp Ile Glu Lys Lys Ile Asn Asp
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 Ile Gln Lys Tyr Glu Glu Glu Ile Ser Glu Lys Glu Ser Lys Leu Thr
 370 375 380
 Gln Ala Ile Ser Glu Lys Glu Gln Ile Leu Lys Gln Leu His Lys Tyr
 385 390 395 400
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 405 410 415
 Glu Lys Glu Gln Ile Leu Lys Gln Leu His Ile Val Gln Glu Gln Leu
 420 425 430
 Glu His Tyr Phe Ile Glu Asn Gln Glu Ile Lys Lys Lys Leu Pro Pro
 435 440 445
 Val Leu Tyr Gly Ala Ala Glu Gln Ile Lys Gln Glu Leu Gly Tyr Arg
 450 455 460
 Leu Gly Tyr Ile Ile Val Ser Tyr Ser Lys Ser Leu Lys Gly Ile Ile
 465 470 475 480
 Thr Met Pro Phe Ala Leu Ile Arg Glu Cys Val Phe Glu Lys Lys Arg
 485 490 495
 Lys Lys Ser Tyr Gly Val Asp Val Pro Leu Tyr Leu Tyr Ala Asp Ala
 500 505 510
 Asp Lys Ala Glu Arg Val Lys Lys His Leu Ser Tyr Gln Leu Gly Gln
 515 520 525
 Ala Ile Ile Ser Ser Ala Asn Ser Ile Phe Gly Phe Ile Thr Leu Pro
 530 535 540
 Phe Lys Leu Ile Val Val Val Tyr Lys Tyr Arg Arg Ala Lys Ile Lys
 545 550 555 560

Gly Cys

<210> 10
 <211> 150
 <212> PRT
 <213> Pasteurella multocida

<400> 10

Ala Pro Pro Leu Val Ser Ile Ile Met Thr Ser His Asn Thr Glu Lys
 1 5 10 15
 Phe Ile Glu Ala Ser Ile Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn
 20 25 30
 Leu Glu Val Ile Val Val Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln
 35 40 45
 Ile Ala Ser Arg Ile Ala Asn Ser Thr Ser Lys Val Lys Thr Phe Arg
 50 55 60
 Leu Asn Ser Asn Leu Gly Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu

65 70 75 80
 Lys Ser Lys Gly Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys
 85 90 95
 His His Glu Arg Ile Glu Arg Cys Val Asn Ala Leu Leu Ser Asn Lys
 100 105 110
 Asp Asn Ile Ala Val Arg Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr
 115 120 125
 Gln Asn Ile Ile Lys Val Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile
 130 135 140
 Thr Leu Gly Val Tyr Arg
 145 150

<210> 11
 <211> 99
 <212> PRT
 <213> Pasteurella multocida

<400> 11

Tyr Ile Thr Cys Asp Asp Asp Ile Arg Tyr Pro Ala Asp Tyr Ile Asn
 1 5 10 15
 Thr Met Ile Lys Lys Ile Asn Lys Tyr Asn Asp Lys Ala Ala Ile Gly
 20 25 30
 Leu His Gly Val Ile Phe Pro Ser Arg Val Asn Lys Tyr Phe Ser Ser
 35 40 45
 Asp Arg Ile Val Tyr Asn Phe Gln Lys Thr Phe Arg Lys Asp Thr Ala
 50 55 60
 Val Asn Ile Leu Gly Thr Gly Thr Val Ala Phe Arg Val Ser Ile Phe
 65 70 75 80
 Asn Lys Phe Ser Leu Ser Asp Phe Glu His Pro Gly Met Val Asp Ile
 85 90 95
 Tyr Phe Ser

<210> 12
 <211> 1722
 <212> DNA
 <213> Pasteurella multocida

<400> 12

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acaaaagaaa gactaggagc cccccctcta gtcagtatta taatgacttc tcataataca	180
gaaaaattca ttgaagcctc aattaattca ctattattgc aaacatacaa taacttagaa	240
gttatcggtg tagatgatta tagcacagat aaaacatttc agatcgcatc cagaatagca	300
aactctacaa gtaaagtaaa aacattccga ttaaactcaa atctagggac atactttgcg	360
aaaaatacag gaatttttaa gtctaaagga gatattattt tctttcagga tagcgatgat	420
gtatgtcacc atgaaagaat cgaaagatgt gttaatgcat tattatcgaa taaagataat	480

atagctgtta gatgtgcata ttctagaata aatctagaaa cacaaaatat aataaaagtt 540
 aatgataata aatacaaatt aggattaata actttaggcg tttatagaaa agtatttaat 600
 gaaattgggt tttttaactg cacaaccaa gcatcggatg atgaatttta tcatagaata 660
 attaaatact atggtaaaaa taggataaat aacttatttc taccactgta ttataacaca 720
 atgcgtgaag attcattatt ttctgatatg gttgagtggg tagatgaaaa taatataaag 780
 caaaaaacct ctgatgctag acaaaattat ctccatgaat tccaaaaaat acacaatgaa 840
 aggaaattaa atgaattaaa agagattttt agctttccta gaattcatga cgccttacct 900
 atatcaaaag aaatgagtaa gctcagcaac cctaaaattc ctgtttatat aaatatatgc 960
 tcaatacctt caagaataaa acaacttcaa tacactattg gagtactaaa aaaccaatgc 1020
 gatcattttc atatttatct tgatggatat ccagaagtac ctgattttat aaaaaaacta 1080
 gggaataaag cgaccgttat taattgtcaa aacaaaaatg agtctattag agataatgga 1140
 aagtttattc tattgaaaa acttataaag gaaaaataa atggatatta tataacttgt 1200
 gatgatgata tccggtatcc tgctgactac ataaacacta tgataaaaaa aattaataaa 1260
 tacaatgata aagcagcaat tggattacat ggtgttatat tcccaagtag agtcaacaag 1320
 tatttttcat cagacagaat tgtctataat tttcaaaaac ctttagaaaa tgatactgct 1380
 gtaaatatat taggaactgg aactgttgcc tttagagtat ctatttttaa taaattttct 1440
 ctatctgatt ttgagcatcc tggcatggtg gatattctatt tttctatact atgtaagaaa 1500
 aacaatatac tccaagtttg tatatcacga ccacgaatt ggctaacaga agataacaaa 1560
 aacactgaga ccttatttca tgaattccaa aatagagatg aaatacaaa taaactcatt 1620
 atttcaaca acccttgggg atactcaagt atatatccat tattaataa taatgctaata 1680
 tattctgaac ttattccgtg tttatctttt tataacgagt aa 1722

<210> 13
 <211> 573
 <212> PRT
 <213> Pasteurella multocida

<400> 13

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Ser Gly Glu Asn Lys Phe Ser Val Ser Ile Lys Asp Leu Tyr Asn Glu
20 25 30

Ile Ser Asn Ser Glu Leu Gly Ile Thr Lys Glu Arg Leu Gly Ala Pro
35 40 45

Pro Leu Val Ser Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile
50 55 60

Glu Ala Ser Ile Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu
65 70 75 80

Val Ile Val Val Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala
85 90 95

Ser Arg Ile Ala Asn Ser Thr Ser Lys Val Lys Thr Phe Arg Leu Asn
100 105 110

Ser Asn Leu Gly Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser
115 120 125

Lys Gly Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His
 130 135 140
 Glu Arg Ile Glu Arg Cys Val Asn Ala Leu Leu Ser Asn Lys Asp Asn
 145 150 155 160
 Ile Ala Val Arg Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn
 165 170 175
 Ile Ile Lys Val Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu
 180 185 190
 Gly Val Tyr Arg Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr
 195 200 205
 Thr Lys Ala Ser Asp Asp Glu Phe Tyr His Arg Ile Ile Lys Tyr Tyr
 210 215 220
 Gly Lys Asn Arg Ile Asn Asn Leu Phe Leu Pro Leu Tyr Tyr Asn Thr
 225 230 235 240
 Met Arg Glu Asp Ser Leu Phe Ser Asp Met Val Glu Trp Val Asp Glu
 245 250 255
 Asn Asn Ile Lys Gln Lys Thr Ser Asp Ala Arg Gln Asn Tyr Leu His
 260 265 270
 Glu Phe Gln Lys Ile His Asn Glu Arg Lys Leu Asn Glu Leu Lys Glu
 275 280 285
 Ile Phe Ser Phe Pro Arg Ile His Asp Ala Leu Pro Ile Ser Lys Glu
 290 295 300
 Met Ser Lys Leu Ser Asn Pro Lys Ile Pro Val Tyr Ile Asn Ile Cys
 305 310 315 320
 Ser Ile Pro Ser Arg Ile Lys Gln Leu Gln Tyr Thr Ile Gly Val Leu
 325 330 335
 Lys Asn Gln Cys Asp His Phe His Ile Tyr Leu Asp Gly Tyr Pro Glu
 340 345 350
 Val Pro Asp Phe Ile Lys Lys Leu Gly Asn Lys Ala Thr Val Ile Asn
 355 360 365
 Cys Gln Asn Lys Asn Glu Ser Ile Arg Asp Asn Gly Lys Phe Ile Leu
 370 375 380
 Leu Glu Lys Leu Ile Lys Glu Asn Lys Asp Gly Tyr Tyr Ile Thr Cys
 385 390 395 400
 Asp Asp Asp Ile Arg Tyr Pro Ala Asp Tyr Ile Asn Thr Met Ile Lys
 405 410 415
 Lys Ile Asn Lys Tyr Asn Asp Lys Ala Ala Ile Gly Leu His Gly Val
 420 425 430
 Ile Phe Pro Ser Arg Val Asn Lys Tyr Phe Ser Ser Asp Arg Ile Val
 435 440 445

Tyr Asn Phe Gln Lys Pro Leu Glu Asn Asp Thr Ala Val Asn Ile Leu
450 455 460

Gly Thr Gly Thr Val Ala Phe Arg Val Ser Ile Phe Asn Lys Phe Ser
465 470 475 480

Leu Ser Asp Phe Glu His Pro Gly Met Val Asp Ile Tyr Phe Ser Ile
485 490 495

Leu Cys Lys Lys Asn Asn Ile Leu Gln Val Cys Ile Ser Arg Pro Ser
500 505 510

Asn Trp Leu Thr Glu Asp Asn Lys Asn Thr Glu Thr Leu Phe His Glu
515 520 525

Phe Gln Asn Arg Asp Glu Ile Gln Ser Lys Leu Ile Ile Ser Asn Asn
530 535 540

Pro Trp Gly Tyr Ser Ser Ile Tyr Pro Leu Leu Asn Asn Asn Ala Asn
545 550 555 560

Tyr Ser Glu Leu Ile Pro Cys Leu Ser Phe Tyr Asn Glu
565 570

<210> 14
<211> 1626
<212> DNA
<213> Pasteurella multocida

<400> 14
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ttgcaaacat acaataactt agaagttatc gttgtagatg attatagcac agataaaaca 180
tttcagatcg catccagaat agcaaaactt acaagtaaag taaaaacatt ccgattaaac 240
tcaaacttag ggacataact tgcgaaaaat acaggaattt taaagtctaa aggagatatt 300
attttctttc aggatagcga tgatgtatgt caccatgaaa gaatcgaaag atgtgttaat 360
gcattattat cgaataaaga taatatagct gttagatgtg catattctag aataaatcta 420
gaaacacaaa atataataaa agttaatgat aataaataca aattaggatt aataacttta 480
ggcgtttata gaaaagtatt taatgaaatt ggttttttta actgcacaac caaagcatcg 540
gatgatgaat ttatcatag aataattaaa tactatggta aaaataggat aaataactta 600
tttctaccac tgtattataa cacaatgcgt gaagattcat tattttctga tatggttgag 660
tggttagatg aaaataatat aaagcaaaaa acctctgatg ctagacaaaa ttatctccat 720
gaattccaaa aaatacacaa tgaaaggaaa ttaaatgaat taaaagagat ttttagcttt 780
cctagaattc atgacgcctt acctatatca aaagaaatga gtaagctcag caaccctaaa 840
attcctgttt atataaatat atgctcaata cttcaagaa taaaacaact tcaatacact 900
attggagtac taaaaacca atgcgatcat ttcatattt atcttgatgg atatccagaa 960
gtacctgatt ttataaaaaa actaggggaat aaagcgaccg ttattaattg tcaaaacaaa 1020
aatgagtcta ttagagataa tggaaagttt attctattag aaaaacttat aaaggaaaat 1080
aaagatggat attatataac ttgtgatgat gatatccggt atcctgctga ctacataaac 1140
actatgataa aaaaaattaa taaatacaat gataaagcag caattggatt acatggtggt 1200

atattcccaa gtagagtcaa caagtatfff tcatcagaca gaattgtcta taattttcaa 1260
aaaccttttag aaaatgatac tgctgtaaat atattaggaa ctggaactgt tgcctttaga 1320
gtatctatfff ttaataaatt ttctctatct gatfffagac atcctggcat ggtagatatc 1380
tatttttcta tactatgtaa gaaaaacaat atactccaag tttgtatatc acgaccatcg 1440
aattggctaa cagaagataa caaaaacact gagacfftat ttcatgaatt ccaaaataga 1500
gatgaaatac aaagtaaact cattatttca aacaaccfft ggggatactc aagtatatat 1560
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gagtaa 1626

<210> 15
<211> 541
<212> PRT
<213> Pasteurella multocida
<400> 15

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Pro Leu Val Ser Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile
20 25 30
Glu Ala Ser Ile Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu
35 40 45
Val Ile Val Val Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala
50 55 60
Ser Arg Ile Ala Asn Ser Thr Ser Lys Val Lys Thr Phe Arg Leu Asn
65 70 75 80
Ser Asn Leu Gly Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser
85 90 95
Lys Gly Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His
100 105 110
Glu Arg Ile Glu Arg Cys Val Asn Ala Leu Leu Ser Asn Lys Asp Asn
115 120 125
Ile Ala Val Arg Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn
130 135 140
Ile Ile Lys Val Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu
145 150 155 160
Gly Val Tyr Arg Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr
165 170 175
Thr Lys Ala Ser Asp Asp Glu Phe Tyr His Arg Ile Ile Lys Tyr Tyr
180 185 190
Gly Lys Asn Arg Ile Asn Asn Leu Phe Leu Pro Leu Tyr Tyr Asn Thr
195 200 205
Met Arg Glu Asp Ser Leu Phe Ser Asp Met Val Glu Trp Val Asp Glu
210 215 220

Asn Asn Ile Lys Gln Lys Thr Ser Asp Ala Arg Gln Asn Tyr Leu His
 225 230 235 240
 Glu Phe Gln Lys Ile His Asn Glu Arg Lys Leu Asn Glu Leu Lys Glu
 245 250 255
 Ile Phe Ser Phe Pro Arg Ile His Asp Ala Leu Pro Ile Ser Lys Glu
 260 265 270
 Met Ser Lys Leu Ser Asn Pro Lys Ile Pro Val Tyr Ile Asn Ile Cys
 275 280 285
 Ser Ile Pro Ser Arg Ile Lys Gln Leu Gln Tyr Thr Ile Gly Val Leu
 290 295 300
 Lys Asn Gln Cys Asp His Phe His Ile Tyr Leu Asp Gly Tyr Pro Glu
 305 310 315 320
 Val Pro Asp Phe Ile Lys Lys Leu Gly Asn Lys Ala Thr Val Ile Asn
 325 330 335
 Cys Gln Asn Lys Asn Glu Ser Ile Arg Asp Asn Gly Lys Phe Ile Leu
 340 345 350
 Leu Glu Lys Leu Ile Lys Glu Asn Lys Asp Gly Tyr Tyr Ile Thr Cys
 355 360 365
 Asp Asp Asp Ile Arg Tyr Pro Ala Asp Tyr Ile Asn Thr Met Ile Lys
 370 375 380
 Lys Ile Asn Lys Tyr Asn Asp Lys Ala Ala Ile Gly Leu His Gly Val
 385 390 395 400
 Ile Phe Pro Ser Arg Val Asn Lys Tyr Phe Ser Ser Asp Arg Ile Val
 405 410 415
 Tyr Asn Phe Gln Lys Pro Leu Glu Asn Asp Thr Ala Val Asn Ile Leu
 420 425 430
 Gly Thr Gly Thr Val Ala Phe Arg Val Ser Ile Phe Asn Lys Phe Ser
 435 440 445
 Leu Ser Asp Phe Glu His Pro Gly Met Val Asp Ile Tyr Phe Ser Ile
 450 455 460
 Leu Cys Lys Lys Asn Asn Ile Leu Gln Val Cys Ile Ser Arg Pro Ser
 465 470 475 480
 Asn Trp Leu Thr Glu Asp Asn Lys Asn Thr Glu Thr Leu Phe His Glu
 485 490 495
 Phe Gln Asn Arg Asp Glu Ile Gln Ser Lys Leu Ile Ile Ser Asn Asn
 500 505 510
 Pro Trp Gly Tyr Ser Ser Ile Tyr Pro Leu Leu Asn Asn Ala Asn
 515 520 525
 Tyr Ser Glu Leu Ile Pro Cys Leu Ser Phe Tyr Asn Glu
 530 535 540

<210> 16
 <211> 34
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> sense primer

 <400> 16
 atgaatataa cacaatcaaa aagtaataaa atag 34

 <210> 17
 <211> 31
 <212> DNA
 <213> Artificial sequence

 <220>
 <223> sense primer

 <400> 17
 atgagcaata gtgaattagg gattacaaaa g 31

 <210> 18
 <211> 28
 <212> DNA
 <213> Artificial sequence

 <220>
 <223> sense primer

 <400> 18
 atgagcttat ttaaactgtc tactgagc 28

 <210> 19
 <211> 34
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> anti-sense primer

 <400> 19
 tttactcgtt ataaaaagat aaacacggaa taag 34

 <210> 20
 <211> 25
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> sense primer

 <400> 20
 atgaagagaa aaaaagagat gactc 25

 <210> 21
 <211> 30
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> anti-sense primer

 <400> 21
 atcattataa aaaataaaaa ggtaaacagg 30

 <210> 22
 <211> 78
 <212> PRT
 <213> Artificial Sequence

 <220>
 <223> Motif I

<220>
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 <223> any amino acid

<220>
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 <222> (6)..(6)
 <223> L or I

<220>
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 <223> any amino acid

<220>
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 <223> any amino acid

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<220>
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 <223> K or N

<220>
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 <223> T or S

<220>
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<220>
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 <223> any amino acid

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 <223> S or T

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 <222> (73)..(73)
 <223> H or P

<220>
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 <223> any amino acid

<400> 22

Gln Thr Tyr Xaa Asn Xaa Glu Xaa Xaa Xaa Xaa Asp Asp Xaa Xaa Xaa
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Asp Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Ile Ala Xaa Xaa Xaa Xaa
 20 25 30

Xaa Xaa Val Xaa Xaa Xaa Xaa Xaa Xaa Xaa Asn Xaa Gly Xaa Tyr Xaa
 35 40 45

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Phe
 50 55 60

Gln Asp Xaa Asp Asp Xaa Xaa His Xaa Glu Arg Ile Xaa Arg
 65 70 75

<210> 23
 <211> 82
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Motif II

<220>
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 <223> K or R

<220>
 <221> MISC_FEATURE
 <222> (3)..(3)
 <223> any amino acid

<220>
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<223> R or I

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<221> MISC_FEATURE

<222> (27)..(27)

<223> any amino acid

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<221> MISC_FEATURE

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<223> any amino acid

<220>

<221> MISC_FEATURE

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<223> any amino acid

<220>

<221> MISC_FEATURE

<222> (73)..(73)

<223> one to ten amino acids

<220>

<221> MISC_FEATURE

<222> (76)..(76)

<223> any amino acid

<400> 23

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1 5 10 15

Xaa Xaa Xaa Asp Asp Ile Xaa Tyr Pro Xaa Asp Tyr Xaa Xaa Xaa
20 25 30

Met Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa
35 40 45

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa
50 55 60

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Val Asn Xaa Leu Gly Thr Gly
65 70 75 80

Thr Val

<210> 24

<211> 1854

<212> DNA

<213> Pasteurella multocida

<400> 24

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gatatatgta aaaaaaatat aacacaatca aaaagtaata aaatagaaga agataatatt 180
tctggagaaa acaaaatttc agtatcaata aaagatctat ataacgaaat aagcaatagt 240
gaattaggga ttacaaaaga aagactagga gccccccctc tagtcagtat tataatgact 300
tctcataata cagaaaaatt cattgaagcc tcaattaatt cactattatt gcaaacatac 360
aataacttag aagttatcgt tgtagatgat tatagcacag ataaaacatt tcagatcgca 420
tccagaatag caaactctac aagtaaagta aaaacattcc gattaaactc aaatctaggg 480
acatactttg cgaaaaatac aggaatttta aagtctaaag gagatattat tttctttcag 540
aatagcaatg atgtatgtca ccatgaaaga atcgaaagat gtgttaatgc attattatcg 600
aataaagata atatagctgt tagatgtgca tattctagaa taaatctaga aacacaaat 660

ataataaaag ttaatgataa taaatacaaa ttaggattaa taactttagg cgtttataga 720
 aaagtattta atgaaattgg tttttttaac tgcacaacca aagcatcgga tgatgaattt 780
 tatcatagaa taattaaata ctatggtaaa aataggataa ataacttatt tctaccactg 840
 tattataaca caatgcgtga agattcatta ttttctgata tggttgagtg ggtagatgaa 900
 aataatataa agcaaaaaac ctctgatgct agacaaaatt atctccatga attccaaaaa 960
 atacacaatg aaaggaaatt aaatgaatta aaagagattt ttagctttcc tagaattcat 1020
 gacgccttac ctatatcaaa agaagttagt aagctcagca accctaaaat tcctgtttat 1080
 ataaatatat gctcaatacc ttcaagaata aaacaacttc aatacactat tggagtacta 1140
 aaaaaccaat gcgatcatth tcatatttat ctgatggat atccagaagt acctgatttt 1200
 ataaaaaac tagggaataa agcgaccgtt attaattgtc aaaacaaaaa tgagtctatt 1260
 agagataatg gaaagtttat tctattagaa aaacttataa aggaaaataa agatggatat 1320
 tatataactt gtgatgatga tatccggtat cctgctgact acataaacac tatgataaaa 1380
 aaaattaata aatacaatga taaagcagca attggattac atgggtgttat attcccaagt 1440
 agagtcaaca agtatttttc atcagacaga attgtctata attttcaaaa acctttagaa 1500
 aatgatactg ctgtaaatat attaggaact ggaactgttg ccttttagagt atctattttt 1560
 aataaatttt ctctatctga ttttgagcat cctggcatgg tagatatcta tttttctata 1620
 ctatgtaaga aaaacaatat actccaagtt tgtatatcac gaccatcgaa ttggctaaca 1680
 gaagataaca aaaacactga gaccttattt catgaattcc aaaatagaga tgaaatacaa 1740
 agtaaaactca ttatttcaaa caacccttggt ggatactcaa gtatatatcc attattaaat 1800
 aataatgcta attattctga acttattccg tgtttatctt tttataacga gtaa 1854

<210> 25
 <211> 617
 <212> PRT
 <213> Pasteurella multocida

<400> 25

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 Lys Asp Ala Leu Thr Leu Tyr Glu Asn Ile Ala Lys Ile Tyr Gly Ser
 20 25 30
 Glu Ser Leu Val Lys Tyr Asn Ile Asp Ile Cys Lys Lys Asn Ile Thr
 35 40 45
 Gln Ser Lys Ser Asn Lys Ile Glu Glu Asp Asn Ile Ser Gly Glu Asn
 50 55 60
 Lys Phe Ser Val Ser Ile Lys Asp Leu Tyr Asn Glu Ile Ser Asn Ser
 65 70 75 80
 Glu Leu Gly Ile Thr Lys Glu Arg Leu Gly Ala Pro Pro Leu Val Ser
 85 90 95
 Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile Glu Ala Ser Ile
 100 105 110
 Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu Val Ile Val Val
 115 120 125

Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala Ser Arg Ile Ala
 130 135 140
 Asn Ser Thr Ser Lys Val Lys Thr Phe Arg Leu Asn Ser Asn Leu Gly
 145 150 155 160
 Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly Asp Ile
 165 170 175
 Ile Phe Phe Gln Asn Ser Asn Asp Val Cys His His Glu Arg Ile Glu
 180 185 190
 Arg Cys Val Asn Ala Leu Leu Ser Asn Lys Asp Asn Ile Ala Val Arg
 195 200 205
 Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn Ile Ile Lys Val
 210 215 220
 Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu Gly Val Tyr Arg
 225 230 235 240
 Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr Thr Lys Ala Ser
 245 250 255
 Asp Asp Glu Phe Tyr His Arg Ile Ile Lys Tyr Tyr Gly Lys Asn Arg
 260 265 270
 Ile Asn Asn Leu Phe Leu Pro Leu Tyr Tyr Asn Thr Met Arg Glu Asp
 275 280 285
 Ser Leu Phe Ser Asp Met Val Glu Trp Val Asp Glu Asn Asn Ile Lys
 290 295 300
 Gln Lys Thr Ser Asp Ala Arg Gln Asn Tyr Leu His Glu Phe Gln Lys
 305 310 315 320
 Ile His Asn Glu Arg Lys Leu Asn Glu Leu Lys Glu Ile Phe Ser Phe
 325 330 335
 Pro Arg Ile His Asp Ala Leu Pro Ile Ser Lys Glu Met Ser Lys Leu
 340 345 350
 Ser Asn Pro Lys Ile Pro Val Tyr Ile Asn Ile Cys Ser Ile Pro Ser
 355 360 365
 Arg Ile Lys Gln Leu Gln Tyr Thr Ile Gly Val Leu Lys Asn Gln Cys
 370 375 380
 Asp His Phe His Ile Tyr Leu Asp Gly Tyr Pro Glu Val Pro Asp Phe
 385 390 395 400
 Ile Lys Lys Leu Gly Asn Lys Ala Thr Val Ile Asn Cys Gln Asn Lys
 405 410 415
 Asn Glu Ser Ile Arg Asp Asn Gly Lys Phe Ile Leu Leu Glu Lys Leu
 420 425 430
 Ile Lys Glu Asn Lys Asp Gly Tyr Tyr Ile Thr Cys Asp Asp Asp Ile
 435 440 445

Arg Tyr Pro Ala Asp Tyr Ile Asn Thr Met Ile Lys Lys Ile Asn Lys
 450 455 460
 Tyr Asn Asp Lys Ala Ala Ile Gly Leu His Gly Val Ile Phe Pro Ser
 465 470 475 480
 Arg Val Asn Lys Tyr Phe Ser Ser Asp Arg Ile Val Tyr Asn Phe Gln
 485 490 495
 Lys Pro Leu Glu Asn Asp Thr Ala Val Asn Ile Leu Gly Thr Gly Thr
 500 505 510
 Val Ala Phe Arg Val Ser Ile Phe Asn Lys Phe Ser Leu Ser Asp Phe
 515 520 525
 Glu His Pro Gly Met Val Asp Ile Tyr Phe Ser Ile Leu Cys Lys Lys
 530 535 540
 Asn Asn Ile Leu Gln Val Cys Ile Ser Arg Pro Ser Asn Trp Leu Thr
 545 550 555 560
 Glu Asp Asn Lys Asn Thr Glu Thr Leu Phe His Glu Phe Gln Asn Arg
 565 570 575
 Asp Glu Ile Gln Ser Lys Leu Ile Ile Ser Asn Asn Pro Trp Gly Tyr
 580 585 590
 Ser Ser Ile Tyr Pro Leu Leu Asn Asn Asn Ala Asn Tyr Ser Glu Leu
 595 600 605
 Ile Pro Cys Leu Ser Phe Tyr Asn Glu
 610 615

<210> 26
 <211> 1854
 <212> DNA
 <213> Pasteurella multocida

<400> 26
 atgagcttat ttaaacgtgc tactgagcta ttttaagtcag gaaactataa agatgcacta 60
 actctatatg aaaatatagc taaaatttat ggttcagaaa gccttggttaa atataatatt 120
 gatatatgta aaaaaatat aacacaatca aaaagtaata aaatagaaga agataatatt 180
 tctggagaaa acaaattttc agtatcaata aaagatctat ataacgaaat aagcaatagt 240
 gaattaggga ttacaaaaga aagactagga gccccccctc tagtcagtat tataatgact 300
 tctcataata cagaaaaatt cattgaagcc tcaattaatt cactattatt gcaaacatac 360
 aataacttag aagttatcgt ttagatgat tatagcacag ataaaacatt tcagatcgca 420
 tccagaatag caaactctac aagtaaagta aaaacattcc gattaaactc aaatctaggg 480
 acatactttg cgaaaaatac aggaatttta aagtctaaag gagatattat tttctttcag 540
 gatagcgatg atgtatgtca ccatgaaaga atcgaaagat gtgttaatgc attattatcg 600
 aataaagata atatagctgt tagatgtgca tattctagaa taaatctaga aacacaaaat 660
 ataataaaag ttaatgataa taaatacaaa ttaggattaa taacttttagg cgtttataga 720
 aaagtattta atgaaattgg tttttttaac tgcacaacca aagcatcgga tgatgaattt 780
 tatcatagaa taattaaata ctatggtaaa aataggataa ataacttatt tctaccactg 840
 tattataaca caatgcgtga agattcatta ttttctgata tggttgagtg ggtagatgaa 900

aataatataa agcaaaaaac ctctgatgct agacaaaatt atctccatga attccaaaaa 960
atacacaatg aaaggaaatt aaatgaatta aaagagattt ttagctttcc tagaattcat 1020
gacgccttac ctatatcaaa agaaatgagt aagctcagca accctaaaat tcctgtttat 1080
ataaatatat gctcaatacc ttcaagaata aaacaacttc aatacactat tggagtacta 1140
aaaaaccaat gcgatcattt tcatatttat cttgatggat atccagaagt acctgatttt 1200
ataaaaaaac tagggaataa agcgaccgtt attaattgtc aaaacaaaaa tgagtctatt 1260
agagataatg gaaagtttat tctattagaa aaacttataa aggaaaaata agatggatat 1320
tatataactt gtaatgataa tatccggtat cctgctgact acataaacac tatgataaaa 1380
aaaattaata aatacaatga taaagcagca attggattac atgggtgttat attcccaagt 1440
agagtcaaca agtatTTTTc atcagacaga attgtctata attttcaaaa accttttagaa 1500
aatgatactg ctgtaatat attaggaact ggaactgttg ccttttagagt atctattttt 1560
aataaatttt ctctatctga ttttgagcat cctggcatgg tagatatcta tttttctata 1620
ctatgtaaga aaaacaatat actccaagtt tgtatatcac gaccatcgaa ttggctaaca 1680
gaagataaca aaaacactga gacctattt catgaattcc aaaatagaga tgaaatacaa 1740
agtaaactca ttatttcaaa caacccttgg ggatactcaa gtatatatcc attattaaat 1800
aataatgcta attattctga acttattccg tgtttatctt tttataacga gtaa 1854

<210> 27
<211> 617
<212> PRT
<213> Pasteurella multocida

<400> 27

Met Ser Leu Phe Lys Arg Ala Thr Glu Leu Phe Lys Ser Gly Asn Tyr
1 5 10 15

Lys Asp Ala Leu Thr Leu Tyr Glu Asn Ile Ala Lys Ile Tyr Gly Ser
20 25 30

Glu Ser Leu Val Lys Tyr Asn Ile Asp Ile Cys Lys Lys Asn Ile Thr
35 40 45

Gln Ser Lys Ser Asn Lys Ile Glu Glu Asp Asn Ile Ser Gly Glu Asn
50 55 60

Lys Phe Ser Val Ser Ile Lys Asp Leu Tyr Asn Glu Ile Ser Asn Ser
65 70 75 80

Glu Leu Gly Ile Thr Lys Glu Arg Leu Gly Ala Pro Pro Leu Val Ser
85 90 95

Ile Ile Met Thr Ser His Asn Thr Glu Lys Phe Ile Glu Ala Ser Ile
100 105 110

Asn Ser Leu Leu Leu Gln Thr Tyr Asn Asn Leu Glu Val Ile Val Val
115 120 125

Asp Asp Tyr Ser Thr Asp Lys Thr Phe Gln Ile Ala Ser Arg Ile Ala
130 135 140

Asn Ser Thr Ser Lys Val Lys Thr Phe Arg Leu Asn Ser Asn Leu Gly
145 150 155 160

Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly Asp Ile
 165 170 175
 Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His Glu Arg Ile Glu
 180 185 190
 Arg Cys Val Asn Ala Leu Leu Ser Asn Lys Asp Asn Ile Ala Val Arg
 195 200 205
 Cys Ala Tyr Ser Arg Ile Asn Leu Glu Thr Gln Asn Ile Ile Lys Val
 210 215 220
 Asn Asp Asn Lys Tyr Lys Leu Gly Leu Ile Thr Leu Gly Val Tyr Arg
 225 230 235 240
 Lys Val Phe Asn Glu Ile Gly Phe Phe Asn Cys Thr Thr Lys Ala Ser
 245 250 255
 Asp Asp Glu Phe Tyr His Arg Ile Ile Lys Tyr Tyr Gly Lys Asn Arg
 260 265 270
 Ile Asn Asn Leu Phe Leu Pro Leu Tyr Tyr Asn Thr Met Arg Glu Asp
 275 280 285
 Ser Leu Phe Ser Asp Met Val Glu Trp Val Asp Glu Asn Asn Ile Lys
 290 295 300
 Gln Lys Thr Ser Asp Ala Arg Gln Asn Tyr Leu His Glu Phe Gln Lys
 305 310 315 320
 Ile His Asn Glu Arg Lys Leu Asn Glu Leu Lys Glu Ile Phe Ser Phe
 325 330 335
 Pro Arg Ile His Asp Ala Leu Pro Ile Ser Lys Glu Met Ser Lys Leu
 340 345 350
 Ser Asn Pro Lys Ile Pro Val Tyr Ile Asn Ile Cys Ser Ile Pro Ser
 355 360 365
 Arg Ile Lys Gln Leu Gln Tyr Thr Ile Gly Val Leu Lys Asn Gln Cys
 370 375 380
 Asp His Phe His Ile Tyr Leu Asp Gly Tyr Pro Glu Val Pro Asp Phe
 385 390 395 400
 Ile Lys Lys Leu Gly Asn Lys Ala Thr Val Ile Asn Cys Gln Asn Lys
 405 410 415
 Asn Glu Ser Ile Arg Asp Asn Gly Lys Phe Ile Leu Leu Glu Lys Leu
 420 425 430
 Ile Lys Glu Asn Lys Asp Gly Tyr Tyr Ile Thr Cys Asn Asp Asn Ile
 435 440 445
 Arg Tyr Pro Ala Asp Tyr Ile Asn Thr Met Ile Lys Lys Ile Asn Lys
 450 455 460
 Tyr Asn Asp Lys Ala Ala Ile Gly Leu His Gly Val Ile Phe Pro Ser
 465 470 475 480

Arg Val Asn Lys Tyr Phe Ser Ser Asp Arg Ile Val Tyr Asn Phe Gln
 485 490 495
 Lys Pro Leu Glu Asn Asp Thr Ala Val Asn Ile Leu Gly Thr Gly Thr
 500 505 510
 Val Ala Phe Arg Val Ser Ile Phe Asn Lys Phe Ser Leu Ser Asp Phe
 515 520 525
 Glu His Pro Gly Met Val Asp Ile Tyr Phe Ser Ile Leu Cys Lys Lys
 530 535 540
 Asn Asn Ile Leu Gln Val Cys Ile Ser Arg Pro Ser Asn Trp Leu Thr
 545 550 555 560
 Glu Asp Asn Lys Asn Thr Glu Thr Leu Phe His Glu Phe Gln Asn Arg
 565 570 575
 Asp Glu Ile Gln Ser Lys Leu Ile Ile Ser Asn Asn Pro Trp Gly Tyr
 580 585 590
 Ser Ser Ile Tyr Pro Leu Leu Asn Asn Asn Ala Asn Tyr Ser Glu Leu
 595 600 605
 Ile Pro Cys Leu Ser Phe Tyr Asn Glu
 610 615

<210> 28
 <211> 42
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> sense primer

<400> 28
 atattatttt ctttcagaat agcaatgatg tatgtcacca tg 42

<210> 29
 <211> 42
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> antisense primer

<400> 29
 catggtgaca tacatcattg ctattctgaa agaaaataat at 42

<210> 30
 <211> 37
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> sense primer

<400> 30
 gatattatat aacttgtaat gataatatcc ggtatcc 37

<210> 31
 <211> 37
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> antisense primer

<400> 31
ggataccgga tattatcatt acaagttata taatatc 37

<210> 32
<211> 21
<212> PRT
<213> artificial sequence

<220>
<223> synthetic peptide

<400> 32
Lys Gly Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His
1 5 10 15

Glu Arg Ile Glu Arg
20

<210> 33
<211> 1956
<212> DNA
<213> Pasteurella multocida

<400> 33
atgaagggaa aaaaagagat gactcaaatt caaatagcta aaaatccacc ccaacatgaa 60
aaagaaaatg aactcaacac ctttcaaaat aaaattgata gtctaaaaac aactttaaac 120
aaagacatca ttttcaaca aactttattg gcaaaacagg acagtaaaca tccgctatcc 180
gcatcccttg aaaacgaaaa taaactttta ttaaaacaac tccaattggt tctgcaagaa 240
tttgaaaaaa tatataccta taatcaagca ttagaagcaa agctagaaaa agataagcaa 300
acaacatcaa taacagatgt atataatgaa gtcgctaaaa gtgatttagg gttagtcaaa 360
gaaactaaca gcgcaaatcc attagtcagt attatcatga catctcaca tacagcgcaa 420
tttatcgaag cttctattaa ttcattattg ttacaacat ataaaaacat agaaattatt 480
attgtagatg atgatatgct ggataatata tttgaaattg cctcgagaat agcgaatacg 540
acaagcaaag tcagagtatt tagattaaat tcaaacctag gaacttactt tgcgaaaaat 600
acaggcatat taaaatctaa aggtgacatt attttctttc aagatagtga tgatgtatgt 660
catcatgaaa gaatagaaag atgtgtaaat atattattag ctaataaaga aactattgct 720
gttcgttggt catactcaag actagcacca gaaacacaac atatcattaa agtcaataat 780
atggattata gattagggtt tataaccttg ggtatgcaca gaaaagtatt tcaagaaatt 840
ggtttcttca attgtacgac taaaggctca gatgatgagt tttttcatag aattgcgaaa 900
tattatggaa aagaaaaaat aaaaaattta ctcttgccgt tatactacaa cacaatgaga 960
gaaaactctt tatttactga tatggttgaa tggatagaca atcataacat aatacagaaa 1020
atgtctgata ccagacaaca ttatgcaacc ctgtttcaag cgatgcataa cgaaactgcc 1080
tcacatgatt tcaaaaatct ttttcaattc cctcgtattt acgatgcctt accagtacca 1140
caagaaatga gtaagttgtc caatcctaag attcctgttt atatcaatat ttgttctatt 1200
ccctcaagaa tagcgcaatt acgacgtatt atcggcatac taaaaaatca atgtgatcat 1260
tttcatattt atcttgatgg ctatgtagaa atccctgact tcataaaaaa tttaggtaat 1320
aaagcaaccg ttgttcattg caaagataaa gataactcca ttagagataa tggcaaattc 1380
attttactgg aagagttgat tgaaaaaat caagatggat attatataac ctgtgatgat 1440
gacattatct atccaagcga ttacatcaat acgatgatca agaagctgaa tgaatacgat 1500
gataaagcgg ttattggttt acacggcatt ctctttccaa gtagaatgac caaatatttt 1560

tcggcggata gactggtata tagcttctat aaacctctgg aaaaagacaa agcgggtcaat 1620
gtattaggta caggaactgt tagctttaga gtcagtctct ttaatcaatt ttctctttct 1680
gactttaccc attcaggcat ggctgatatc tatttctctc tcttggttaa gaaaaataat 1740
attcttcaga tttgtatttc aagaccagca aactggctaa cagaagataa tagagacagc 1800
gaaacactct atcatcaata tcgagacaat gatgagcaac aaactcagct gatcatggaa 1860
aacggtccat ggggatattc aagtatttat ccattagtca aaaatcatcc taaatttact 1920
gaccttatcc cctgtttacc tttttatttt ttataa 1956

<210> 34
<211> 651
<212> PRT
<213> Pasteurella multocida

<400> 34

Met Lys Arg Lys Lys Glu Met Thr Gln Ile Gln Ile Ala Lys Asn Pro
1 5 10 15

Pro Gln His Glu Lys Glu Asn Glu Leu Asn Thr Phe Gln Asn Lys Ile
20 25 30

Asp Ser Leu Lys Thr Thr Leu Asn Lys Asp Ile Ile Ser Gln Gln Thr
35 40 45

Leu Leu Ala Lys Gln Asp Ser Lys His Pro Leu Ser Ala Ser Leu Glu
50 55 60

Asn Glu Asn Lys Leu Leu Lys Gln Leu Gln Leu Val Leu Gln Glu
65 70 75 80

Phe Glu Lys Ile Tyr Thr Tyr Asn Gln Ala Leu Glu Ala Lys Leu Glu
85 90 95

Lys Asp Lys Gln Thr Thr Ser Ile Thr Asp Leu Tyr Asn Glu Val Ala
100 105 110

Lys Ser Asp Leu Gly Leu Val Lys Glu Thr Asn Ser Ala Asn Pro Leu
115 120 125

Val Ser Ile Ile Met Thr Ser His Asn Thr Ala Gln Phe Ile Glu Ala
130 135 140

Ser Ile Asn Ser Leu Leu Leu Gln Thr Tyr Lys Asn Ile Glu Ile Ile
145 150 155 160

Ile Val Asp Asp Asp Ser Ser Asp Asn Thr Phe Glu Ile Ala Ser Arg
165 170 175

Ile Ala Asn Thr Thr Ser Lys Val Arg Val Phe Arg Leu Asn Ser Asn
180 185 190

Leu Gly Thr Tyr Phe Ala Lys Asn Thr Gly Ile Leu Lys Ser Lys Gly
195 200 205

Asp Ile Ile Phe Phe Gln Asp Ser Asp Asp Val Cys His His Glu Arg
210 215 220

Ile Glu Arg Cys Val Asn Ile Leu Leu Ala Asn Lys Glu Thr Ile Ala

545		550		555		560
Asp Phe Thr His	Ser 565	Gly Met Ala Asp	Ile 570	Tyr Phe Ser	Leu 575	Leu Cys
Lys Lys Asn	Asn 580	Ile Leu Gln	Ile 585	Cys Ser Arg	Pro 590	Ala Asn Trp
Leu Thr	Glu 595	Asp Asn Arg	Asp 600	Ser Glu Thr	Leu Tyr	His 605
Gln Tyr Arg						
Asp Asn Asp	Glu 610	Gln Gln Thr	Gln 615	Leu Ile Met	Glu 620	Asn Gly Pro Trp
Gly Tyr Ser	Ser 625	Ile Tyr Pro	Leu Val	Lys Asn 635	His Pro Lys	Phe Thr 640
Asp Leu Ile	Pro 645	Cys Leu Pro	Phe Tyr	Phe 650	Leu	